IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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CASE: **CANNON 103-92-50**

TITLE: **HANDSET PROXIMITY MUTING**

PATENT APPLICATION TRANSMITTAL LETTER

Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

SIR:

Enclosed are the following papers relating to the above-named application for patent:

Specification (including cover sheet, claims and Abstract) - 23 pages
7 informal sheets of drawings
1 Assignment with Cover Sheet - 5 pages
Declaration and Power of Attorney - 5 pages

CLAIMS AS FILED				
	NO. FILED	NO. EXTRA	RATE	CALCULATIONS
Total Claims	27 - 20 =	7	x $18 =	$126
Independent Claims	3 - 3 =	0	x $78 =	$0
Multiple Dependent Claim(s), if applicable			$260 =	$0
Basic Fee				$690
			TOTAL FEE:	$816

Please file the application and charge **Lucent Technologies Deposit Account No. 12-2325 under Order No. Cannon 103-92-50** the amount of **$816** to cover the filing fee. A copy of this letter is enclosed. To correct any non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325 under Order No. Cannon 103-92-50**.

Please address all correspondence to **FARKAS & MANELLI, PLLC, 2000 M Street, N.W. 7th Floor, Washington, DC 20036-3307**, and all telephone calls to William H. Bollman at (202) 261-1000.

Respectfully submitted,

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Date: June 9, 2000

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APPLICATION UNDER UNITED STATES PATENT LAWS

Invention: **HANDSET PROXIMITY MUTING**

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This is a:

[ ] Provisional Application

[X] Regular Utility Application

[ ] Continuing Application

[ ] PCT National Phase Application

[ ] Design Application

[ ] Reissue Application

[ ] Plant Application

SPECIFICATION

HANDSET PROXIMITY MUTING

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to cordless telephones. More particularly, it relates to cordless telephones having improved audio feedback control, especially when the cordless telephone is operating in a speakerphone mode.

2. Background of Related Art

Many cordless telephones come with a speakerphone built into the base. The user typically has the ability to carry on a conversation using the handset alone, or using the base unit alone as a speakerphone. Many cordless telephones permit both the handset and the base unit to be operated simultaneously, allowing one person to participate in a telephone call using the handset while another person participates using the base unit.

The physical environment of the cordless telephone may cause direct or indirect audible echoes in the audio signals between the handset and the base unit. For instance, a primary source of acoustical feedback is caused from sounds output by the speaker of the base unit operating in a speakerphone mode being picked back up by a microphone in the handset. This most frequently occurs when the output sound bounces off the ceiling, walls and other structures in the room. A secondary source of acoustic feedback results from sounds output from the handset and picked up by the base unit.

As many users of such a cordless telephone know, acoustical feedback typically causes uncomfortable feedback such as squealing in the signal output from the speaker. Thus, care must be taken when using both the handset and the base unit simultaneously to maintain

a safe distance between the simultaneously operating handset and base unit to avoid acoustic feedback.

However, even with the risk of acoustic feedback causing a howl, there may be times when it is desired to have both the handset and the base unit operating in close proximity. For instance, if the user of the handset is moving about a room, and passes by the base unit simultaneously operating as a speakerphone.

Fig. 7 shows a conventional base unit **700** and handset **702** of a cordless telephone during an acoustical feedback scenario.

In particular, as shown in Fig. 7, both the handset **702** and the base unit **700** are operating simultaneously in close proximity to one another. This causes primary acoustical feedback from sound output by the speaker **760** of the base unit being picked up by the microphone **752** of the handset **702**, and even in some cases secondary feedback from sound output by the speaker **750** of the handset being picked up by the microphone **762** of the base unit **700**. These are relatively low loss feedback paths which may become unstable, cause howling from the speaker of the base unit and/or from the speaker of the remote handset.

Some cordless telephones include acoustic echo cancellers (AECs). Conventional acoustical echo cancellers suppress audio picked up by a microphone which was output by a speaker on the same telephone. These conventional AECs are typically adaptive, speech trained and monitored and adjusted as necessary for optimal performance.

AECs typically perform well with acoustic reflections off a wall or ceiling, but operate less effectively and even not at all when trying to overcome the acoustic feedback problems associated with the howl caused when an operating handset comes within close proximity of its base unit while in speakerphone mode.

The same problems are associated with a handset of a cordless telephone which is capable of operating in a speakerphone mode.

There is a need for apparatus and methods for reducing or eliminating the risk or danger of acoustical feedback in cordless telephones.

SUMMARY OF THE INVENTION

In accordance with the principles of the present invention, an audio path attenuation controller for a cordless telephone comprises a proximity determinator to determine a distance between a handset of the cordless telephone and a base unit of the cordless telephone, and to effectuate a given attenuation of an audio path based on the determined distance.

A method of attenuating an audio path of a cordless telephone in accordance with another aspect of the present invention comprises determining a proximity of a handset of the cordless telephone to a base unit of the cordless telephone, and attenuating at least one audio path between the handset and the base unit when the handset is within a predetermined close distance to the base unit. The attenuation prevents instability in audible feedback between the handset and the base unit.

BRIEF DESCRIPTION OF THE DRAWINGS

Features and advantages of the present invention will become apparent to those skilled in the art from the following description with reference to the drawings, in which:

Fig. 1 shows a cordless telephone including a proximity detection module in a base unit, and gain/volume controllers in both the base unit and the handset, for muting or attenuating a microphone and/or

speaker path when a simultaneously handset and base unit come within close proximity of one another, in accordance with the principles of the present invention.

Fig. 2 shows a cordless telephone including a proximity detection module in a handset, and gain/volume controllers in both the base unit and the handset, for muting or attenuating a microphone and/or speaker path when a simultaneously handset and base unit come within close proximity of one another, in accordance with the principles of the present invention.

Fig. 3 shows an exemplary process for muting or attenuating a microphone path in a handset and/or in a base unit of a cordless telephone when the handset and the base unit are simultaneously operating within close proximity of one another, in accordance with the principles of the present invention.

Fig. 4 shows in detail a first embodiment of the proximity detection module shown in Figs. 1 and 2 implementing a receive signal strength indicator (RSSI) module as a basis for determining a proximity of a simultaneously operating handset and base unit of a cordless telephone, in accordance with the principles of the present invention.

Fig. 5 shows in detail a second embodiment of the proximity detection module shown in Figs. 1 and 2 implementing a round trip delay measurement module as a basis for determining the proximity of a simultaneously operating handset and base unit of a cordless telephone, in accordance with the principles of the present invention.

Fig. 6 shows in detail a third embodiment of the proximity detection module shown in Figs. 1 and 2 implementing a global positioning satellite (GPS) system as a basis for determining the proximity of a simultaneously operating handset and base unit of a cordless telephone, in accordance with the principles of the present invention.

Fig. 7 shows a conventional base unit and handset of a cordless telephone during an acoustical feedback scenario.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

The present invention relates to apparatus and methods for automatically (i.e., without requiring manual user adjustment) reducing gain in one or both acoustic feedback paths of a cordless telephone when the handset and its base unit are operating in close proximity to one another.

Operation of the base unit generally refers to operation of the base unit in a speakerphone or intercom mode. In either of these modes, when the handset is also in operation, an audio link is established by the cordless telephone between the user of the remote handset and the user of the base unit. As discussed, this audio link can be the source of very uncomfortable audible howling if the user of the remote handset moves too close to the base unit while the base unit is also in operation.

In accordance with the principles of the present invention, if both the remote handset and the base unit of a particular cordless telephone are simultaneously in operation, then the proximity of the remote handset to the base unit is determined. If the remote handset is determined to be within close proximity of the base unit (e.g., less than 10 feet, less than 5 feet, or other appropriate threshold proximity distance), then the gain of the audio path in either direction between the remote handset and its base unit is attenuated.

The attenuation may be a muting, a fixed amount of attenuation (e.g., 6 decibels (dB), 12 dB, or other appropriate fixed amount), or may be a variable amount of attenuation dependent upon a relationship to the distance between the remote handset and the base unit.

For instance, if a variable relationship is implemented, a non-linear amount of attenuation with respect to the distance (e.g., one-over the square-root of the distance) may be preferred. This would ensure that the cordless telephone can remain functional even with the remote handset within close proximity of its base unit up to a certain point, with very close distances essentially causing a muting of one or both audio paths. Using a variable relationship, the closer the handset is to the base unit, the more attenuation would be added, preferably in stepwise increments (e.g., in steps of 3 dB).

Fig. 1 shows a cordless telephone including a proximity detection module **100** in a base unit **190**, and gain/volume controllers **112**, **162** in both the base unit **190** and the handset **102**, respectively, for muting or attenuating an audio path (e.g., the gain a microphone and/or the volume of a speaker) when a simultaneously operating handset **102** and base unit **190** come within close proximity of one another, in accordance with the principles of the present invention.

In particular, as shown in Fig. 1, a cordless telephone includes a remote handset **102** and a matching base unit **190**. The remote handset **102** includes a speaker including an electronically controlled speaker volume **160**, and a microphone including an electronically controlled microphone gain module **164**. The speaker volume **160** and microphone gain **164** are set by an appropriate control element such as a gain/volume controller **162**. The gain/volume controller **162** may be any suitable processing element for the particular application, e.g., a microprocessor, a microcontroller, a digital signal processor (DSP) or ASIC.

Similarly, the base unit **190** includes a speaker including an electronically controlled speaker volume **110**, and a microphone including an electronically controlled microphone gain module **114**. The speaker

volume **110** and microphone gain **114** are set by an appropriate control element such as a gain/volume controller **112**.

In accordance with the principles of the present invention, the cordless telephone includes a proximity detection module **100** either in the base unit **190** (as shown in Fig. 1), or in the remote handset **102** (as shown in Fig. 2). The proximity detection module **100** determines (1) if the handset **102** and its base unit **190** are simultaneously operating, (2) an approximate distance between the remote handset **102** and its base unit **190**, and (3) an amount of attenuation to be applied to a particular audio path.

The proximity detection module **100** may be a software program running on an appropriate processor (e.g., microprocessor, microcontroller, or digital signal processor (DSP)), or an appropriate ASIC device.

Fig. 3 shows an exemplary process for muting or attenuating a microphone path in a handset **102** and/or in a base unit **190** of a cordless telephone when the handset **102** and the base unit **190** are simultaneously operating within close proximity of one another, in accordance with the principles of the present invention.

In particular, as shown in step **202** of Fig. 3, the proximity detection module **100** determines whether or not the base unit **190** and the remote handset **102** are operating simultaneously (i.e., either in handset, speakerphone, or intercom mode).

If not, in step **204**, the proximity detection module **100** leaves the microphone audio path (and/or speaker volume) unattenuated beyond that otherwise set by the user (e.g., using a manual volume control).

If the remote handset **102** and base unit **190** are both operating, the proximity detection module **100** determines a proximity (i.e.,

distance) of the remote handset **102** to the base unit **190**, as shown in step **206**.

In step **208**, the proximity detection module **100** determines if the proximity determined in step **206** is less than or equal to a particular proximity threshold distance.

The particular proximity threshold distance used may vary among various makes and models of cordless telephones, and is preferably established based on the particular application. The proximity threshold distance may be arbitrarily set (e.g., 5 feet, 10 feet), or determined empirically by the manufacturer. The proximity threshold distance is preferably stored in appropriate memory accessible by the proximity detection module **100**, in accordance with the principles of the present invention.

If the handset **102** is not within the prescribed proximity threshold distance of the base unit **190**, the controlled audio path(s) (e.g., the microphone gain) are left unattenuated, as shown in step **210**.

However, as shown in step **212**, if the handset **102** is within the prescribed proximity threshold distance of the base unit **190**, an appropriate audio path (e.g., the microphone gain **114** or the speaker volume **110**) will be appropriately attenuated (for instance, by a fixed amount of 6 dB or 12 dB).

Thus, in accordance with the principles of the present invention, when the remote handset **102** is determined to be in close proximity to its matching base unit **190**, attenuation may be added to either the base speaker or the base microphone using the electronically controlled base speaker volume **110**, or to the handset microphone using the electronically controlled handset microphone gain **164**.

The proximity detection module **100**, whether located in the base unit **190** as shown in Fig. 1, or in the remote handset **102** as shown in Fig. 2, preferably communicates information over the radio frequency

(RF) link between the base unit **190** and the remote handset **102** regarding the particular amount of attenuation to add to the audio path from the opposite device.

For instance, as shown in Fig. 1, the proximity detection module **100** in the base unit **190** may add attenuation to the microphone gain of the remote handset **102** by passing appropriate information over the RF link to the gain/volume controller **162** of the remote handset **102**. Similarly, if the proximity detection module **100** is located in the remote handset **102** as shown in Fig. 2, the remote handset **102** may add attenuation to the speaker volume of the base unit **190** by passing appropriate information over the RF link to the gain/volume controller **112** of the base unit **190**.

While Figs. 1 and 2 respectively show the proximity detection module **100** in either the base unit **190** or in the remote handset **102**, the functions of the proximity detection module **100** may be spread between the two devices **102, 190.** For instance, the proximity between the remote handset **102** and its base unit **190** may be individually determined by both the base unit **190** and the remote handset **102.** Similarly, given the determination that the operating remote handset **102** is within close proximity of the operating base unit **190,** the attenuation of microphone gains **164, 114** and/or speaker volumes **160, 110** may be separately determined and controlled by the respective device **102, 190.**

In accordance with the principles of the present invention, once the remote handset **102** separates beyond the threshold proximity distance from the base unit **190,** whatever attenuation that was added is then removed.

A preferred technique is to attenuate the primary acoustic feedback path **172** as shown in Fig. 1. In particular, the primary acoustic feedback path **172** can be attenuated by attenuating at the remote handset **102** microphone data picked up at the handset **102**, before

sending the microphone data over the RF link to the base unit **190**, to be passed through the speaker volume **110**, and ultimately to the speaker of the base unit **190**. Moreover, to isolate the other party on the telephone line from the attenuation, the microphone data transmitted on the telephone line from the base unit **190** can be transmitted without the attenuation added at the remote handset **102**. Thus, an appropriate amplification of the microphone data received by the base unit **190** before transmission on the telephone line may be implemented.

Reducing the gain of the microphone in the remote handset **102** does not significantly reduce the usability of the cordless telephone, particularly since at the point where the handset **102** and the base unit **190** would otherwise howl, the user of the handset **102** may be close enough to the base unit **190** that his or her voice would be picked up by the microphone of the base unit **190** operating in a speakerphone or intercom mode, and certainly by the user of the base unit **190**.

The secondary acoustic feedback path **174** from the speaker of the remote handset **102** and the microphone of the base unit **190** may be handled in a similar manner. However, attenuation of the secondary acoustic feedback path **174** is generally of less importance than that of the primary acoustic feedback path **172**. Thus, not as much attenuation would not likely be necessary in the secondary acoustic feedback path **174**, but attenuation nevertheless can be added to the microphone of the base unit **190** after the microphone data is received from by the remote handset **102**. A normal or otherwise user controlled level of microphone data may be transmitted over the telephone line.

Fig. 4 shows in detail a first embodiment of an exemplary proximity detection module shown in Figs. 1 and 2 implementing a receive signal strength indicator (RSSI) module as a basis for determining a proximity of a simultaneously operating handset and base unit of a

cordless telephone, in accordance with the principles of the present invention.

In particular, the proximity of the cordless handset **102** to the base unit **190** can be measured in a number of ways. One exemplary technique for measuring the distance between the remote handset **102** and the base unit **190** is to use a Received Signal Strength Indicator (RSSI). The higher the RSSI, the closer the handset **102** is presumed to be to the base unit **190**.

As shown in Fig. 4, the exemplary proximity detection module **100** includes a proximity determinator **310**, and an RSSI module **320**.

The RSSI module **320** determines an amount of RSSI as is known in the art.

The proximity determinator **310** receives the RSSI from the RSSI module **320**, and compares the RSSI level with an RSSI to distance table **311** or other appropriate information source.

More than one table, and/or a table adjustment factor, may be used to accommodate a current power level of the cordless telephone. For instance, a number of tables can be established each relating to a particular power level utilized by the handset of the cordless telephone.

The proximity determinator **310** associates the current RSSI level with an entry in the RSSI to distance table **311** associating a distance between the remote handset **102** and the base unit **190**, and returns the distance between the remote handset **102** and the base unit **190**.

Given the distance, the proximity determinator **310** determines a desired amount of attenuation to be applied in the audio paths at either the remote handset or at the base unit. The desired amount of attenuation may be fixed and retrieved from an appropriate memory, or variable based on the value of the distance.

A variable amount of attenuation may be determined by the proximity determinator **310**, e.g., from a distance to attenuation table **313**. The distance to attenuation table **313** may associate a distance between the remote handset **102** and the base unit **190** with a particular amount of attenuation for the microphone gain **114** and/or speaker volume **110** of the base unit **190**, and/or with a particular amount of attenuation for the microphone gain **164** and/or speaker volume **160** in the remote handset **102**.

Once the proximity determinator **310** determines the amount of attenuation (if any) desired for the respective audio paths, the attenuation levels are passed electronically and automatically by the proximity determinator **310** directly to the relevant gain/volume controller **112** for the microphone and speaker within the relevant device, and/or via the RF front end to the opposite device.

Fig. 5 shows in detail a second embodiment of an exemplary proximity detection module **100** shown in Figs. 1 and 2 implementing a round trip delay measurement module **420** as a basis for determining the proximity of a simultaneously operating handset **102** and base unit **190** of a cordless telephone, in accordance with the principles of the present invention.

In particular, as shown in Fig. 5, the RSSI module **320** show in Fig. 4 is replaced with a round trip delay measurement module **420**, and the RSSI to distance table **311** shown in Fig. 4 is replaced with a round trip delay to distance table **411**. Otherwise, the operation and functions of the embodiment shown in Fig. 5 are substantially the same as those shown and described with respect to Fig. 4.

The round trip delay to distance table **411** associates a round trip delay time of a particular message passed both ways between the base unit **190** and the remote handset **102**. Entries in the round trip

delay to distance table **411** can be determined empirically from use of the particular make and model cordless telephone.

The round trip delay measurement module **420** generates a command for transmission via the RF front end **139** to the other device of the cordless telephone. A time stamp is associated with the generation and transmission of the timing message. A time of a response is measured. The response may be any appropriate signal, e.g., an acknowledgement signal. The difference between the time at which the response signal was received and the time stamp of the originally transmitted command is a round trip delay.

As this delay increases, the distance between the remote handset **102** and the base unit **190** is presumed to increase. Similarly, as this delay decreases, the proximity of the remote handset **102** to the base unit **190** is presumed to decrease. The threshold proximity distance or a plurality of variable distances) can be associated with a particular round trip delay, in accordance with the principles of the present invention.

The particular message which is passed between the remote handset **102** and the base unit **190** is not important, so long as the message is returned without variations in delays caused other than from the distance between the remote handset **102** and the base unit **190**. Moreover, the message may be a message which is transmitted in the ordinary operation of the cordless telephone, e.g., a polling message between the remote handset **102** and the base unit **190**.

Fig. 6 shows in detail a third embodiment of yet another exemplary proximity detection module shown in Figs. 1 and 2 implementing a global positioning satellite (GPS) system as a basis for determining the proximity of a simultaneously operating handset and base unit of a cordless telephone, in accordance with the principles of the present invention.

In particular, as shown in Fig. 6, a precise distance between the base unit **190** and the remote handset **102** may be measured using a global positioning satellite (GPS) system **520** in the remote handset **102**, although this technique may be more limited than the embodiments shown in Figs. 4 and 5 because of the relatively coarse resolution of a typical GPS system. However, the resolution can be improved using techniques such as differential GPS, which is accurate, e.g., down to centimeters.

The latitude and longitude (and altitude) of the base unit **190** can be measured while the handset **102** is in a non-operational or otherwise on-hook condition, and stored in an appropriate memory accessible by the proximity determinator **310**, e.g., in a base unit GPS position memory or register **517**. When the handset **102** is hung up, the position of the remote handset **102** is presumed to be the position of the typically non-mobile base unit **190**.

During operation of both the remote handset **102** and the base unit **190**, the GPS position of the remote handset is periodically measured using the GPS system **520** located in the remote handset **102**. The current GPS position of the remote handset **102** is compared to the base unit GPS position by the proximity determinator **310** to determine a distance, which is compared to a distance to attenuation table **313**. Based on the GPS measured distance, appropriate attenuation is effected by the proximity determinator **310**.

GPS has the advantage of providing information regarding the position of the handset with respect to the base, and therefore can accommodate various acoustical properties of the base unit and remote handset with respect to one another. For instance, the muting in accordance with the principles of the present invention can be performed at a greater distance when the handset is detected in front of the base unit than when the handset is behind the cordless telephone.

The present invention allows conference calling with use of both a handset and speakerphone base unit of a cordless telephone without risk of howling. The user of the remote handset does not have to go into one room with a handset when the speakerphone base unit is on in another room. Similarly, when the cordless telephone is in an intercom mode, the user of the handset will be able to walk to the base unit without risk of howling, which will be prevented even before it begins.

A proximity detection module in accordance with the principles of the present invention has many applications, e.g., in a cordless telephone chip set to add value and distinctiveness.

While the disclosed embodiments relate to a digital cordless telephone, the proximity muting and/or attenuation relates equally to analog cordless telephones, in accordance with the principles of the present invention.

While the invention has been described with reference to the exemplary embodiments thereof, those skilled in the art will be able to make various modifications to the described embodiments of the invention without departing from the true spirit and scope of the invention.

CLAIMS

What is claimed is:

1. An audio path attenuation controller for a cordless telephone, comprising:

a proximity determinator to determine a distance between a handset of said cordless telephone and a base unit of said cordless telephone, and to effectuate a given attenuation of an audio path based on said determined distance.

2. The audio path attenuation controller for a cordless telephone according to claim 1, wherein:

said cordless telephone has a speakerphone functionality; and

said effected attenuation reducing instability in audible feedback between said handset and said base unit.

3. The audio path attenuation controller for a cordless telephone according to claim 1, wherein:

said given attenuation is a fixed amount of attenuation based on said determined distance being less than or equal to a given threshold proximity distance between said handset and said base unit.

4. The audio path attenuation controller for a cordless telephone according to claim 1, wherein:

said given attenuation is a variable amount of attenuation based on a relationship between a desired amount of attenuation and said determined distance.

5. The audio path attenuation controller for a cordless telephone according to claim 4, wherein:

said desired amount of attenuation is determined from a look up table.

6. The audio path attenuation controller for a cordless telephone according to claim 1, wherein said proximity determinator further comprises:

a receive signal strength indicator module.

7. The audio path attenuation controller for a cordless telephone according to claim 1, wherein said proximity determinator further comprises:

a round trip delay measurement module.

8. The audio path attenuation controller for a cordless telephone according to claim 1, wherein said proximity determinator further comprises:

a global positioning satellite system.

9. The audio path attenuation controller for a cordless telephone according to claim 8, wherein:

said global positioning satellite system is installed in said handset.

10. The audio path attenuation controller for a cordless telephone according to claim 1, wherein:

said proximity determinator determines said distance only when said handset and said base unit are operating simultaneously.

11. The audio path attenuation controller for a cordless telephone according to claim 10, wherein

at least one of said handset and said base unit is operating in a speakerphone mode when said distance is determined.

12. The audio path attenuation controller for a cordless telephone according to claim 1, wherein:

said attenuation is a muting of said audio path.

13. The audio path attenuation controller for a cordless telephone according to claim 1, wherein:

said attenuation is variable in relationship to a distance between said handset and said base unit.

14. The audio path attenuation controller for a cordless telephone according to claim 1, wherein:

said attenuation is a fixed amount of attenuation.

15. A method of attenuating an audio path of a cordless telephone, comprising:

determining a proximity of a handset of said cordless telephone to a base unit of said cordless telephone; and

when said handset is within a predetermined close distance to said base unit, attenuating at least one audio path between said handset and said base unit.

16. The method of attenuating an audio path of a cordless telephone according to claim 15, further comprising:

placing said cordless telephone in a speakerphone mode;

said attenuation reducing instability in audible feedback between said handset and said base unit.

17. The method of attenuating an audio path of a cordless telephone according to claim 16, wherein:

said at least one audio path is a path from a microphone of said handset.

18. The method of attenuating an audio path of a cordless telephone according to claim 15, further comprising:

determining simultaneous operation of said handset and said cordless telephone.

19. The method of attenuating an audio path of a cordless telephone according to claim 15, wherein:

said proximity is determined using a receive signal strength indicator of a received signal.

20. The method of attenuating an audio path of a cordless telephone according to claim 15, wherein:

said proximity is determined using a round trip delay timing of a signal between said handset and said base unit.

21. The method of attenuating an audio path of a cordless telephone according to claim 15, wherein:

said proximity is determined using a difference between a GPS determined location of said handset and a GPS determined location of said base unit.

22. Apparatus for attenuating an audio path of a cordless telephone, comprising:

means for determining a proximity of a handset of said cordless telephone to a base unit of said cordless telephone; and

means for attenuating at least one audio path between said handset and said base unit when said handset is within a predetermined close distance to said base unit;

wherein said attenuation prevents instability in audible feedback between said handset and said base unit.

23. The apparatus for attenuating an audio path of a cordless telephone according to claim 22, wherein:

said at least one audio path is a path from a microphone of said handset.

24. The apparatus for attenuating an audio path of a cordless telephone according to claim 22, further comprising:

means for determining simultaneous operation of said handset and said cordless telephone.

25. The apparatus for attenuating an audio path of a cordless telephone according to claim 22, wherein said means for determining comprises:

a receive signal strength indicator module.

26. The apparatus for attenuating an audio path of a cordless telephone according to claim 22, wherein said means for determining comprises:

a round trip delay measurement module.

27. The apparatus for attenuating an audio path of a cordless telephone according to claim 22, wherein said means for determining comprises:

a global positioning satellite system.

ABSTRACT

Apparatus and methods for automatically (i.e., without requiring manual user adjustment) reducing gain in one or both acoustic feedback paths of a cordless telephone when the handset and its base unit are operating in close proximity to one another, preventing uncontrolled feedback and audible howling even before it begins. A proximity detection module determines a distance between the handset and its base unit using an appropriate technique, e.g., using RSSI, round trip delay times, and/or GPS measurements. If the distance indicates that the handset is within close proximity to the base unit, appropriate attenuation of the microphone gain and/or speaker volume of the base unit and/or the handset will be implemented. One or more fixed levels of attenuation may be implemented based on a corresponding one or more measured close proximity distances between the handset and its base unit. Thus, the attenuation may result in a muting, a fixed amount of attenuation (e.g., 6 decibels (dB), 12 dB, or other appropriate fixed amount), or may be a variable amount dependent upon a relationship to the distance between the handset and the base unit.

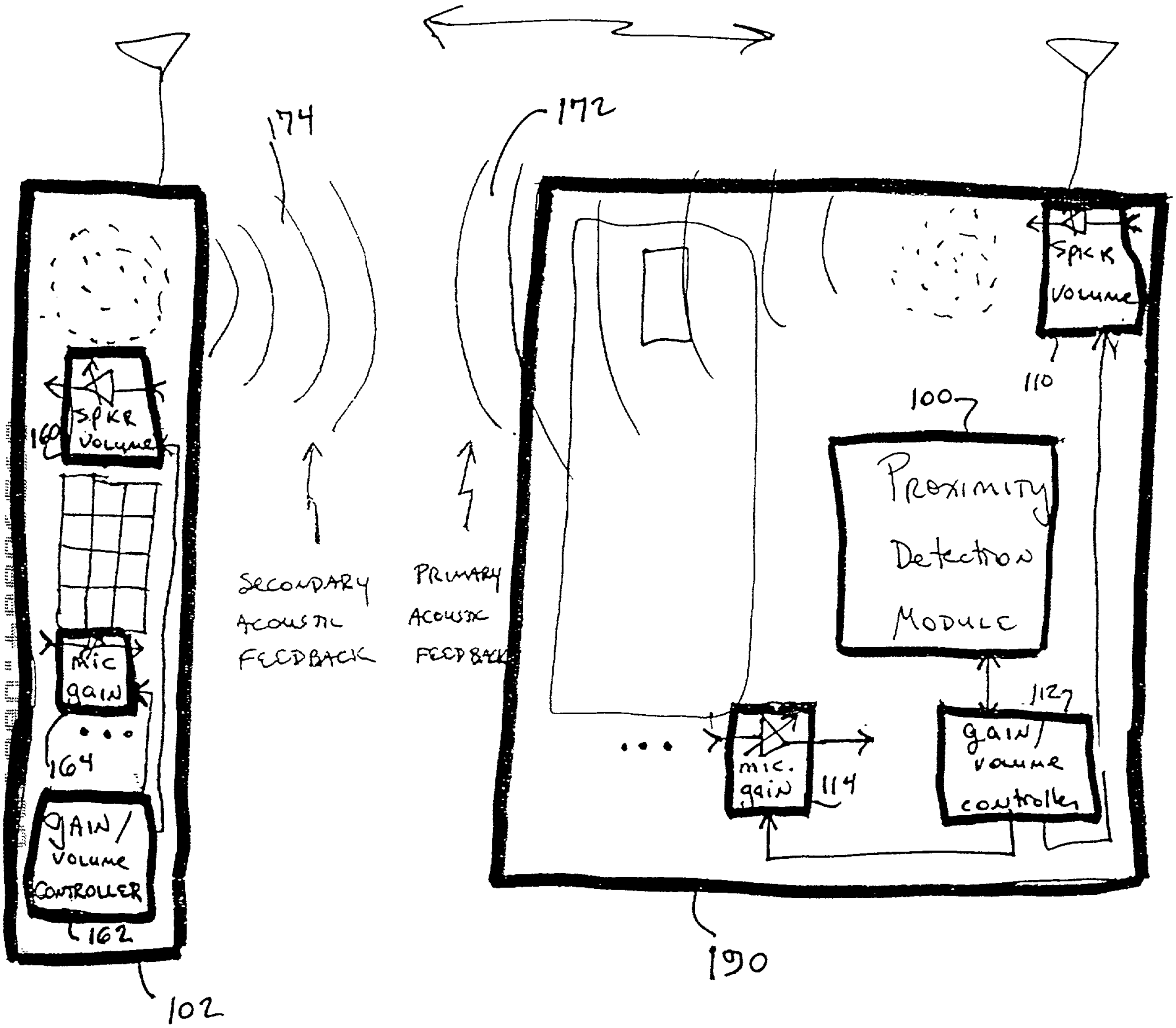

174
172
SPKR Volume
160
mic gain
164
GAIN/ VOLUME CONTROLLER
162
102
SECONDARY ACOUSTIC FEEDBACK
PRIMARY ACOUSTIC FEEDBACK
SPKR Volume
110
100
Proximity Detection Module
112
gain/ volume controller
mic. gain
114
190

FIG. 1

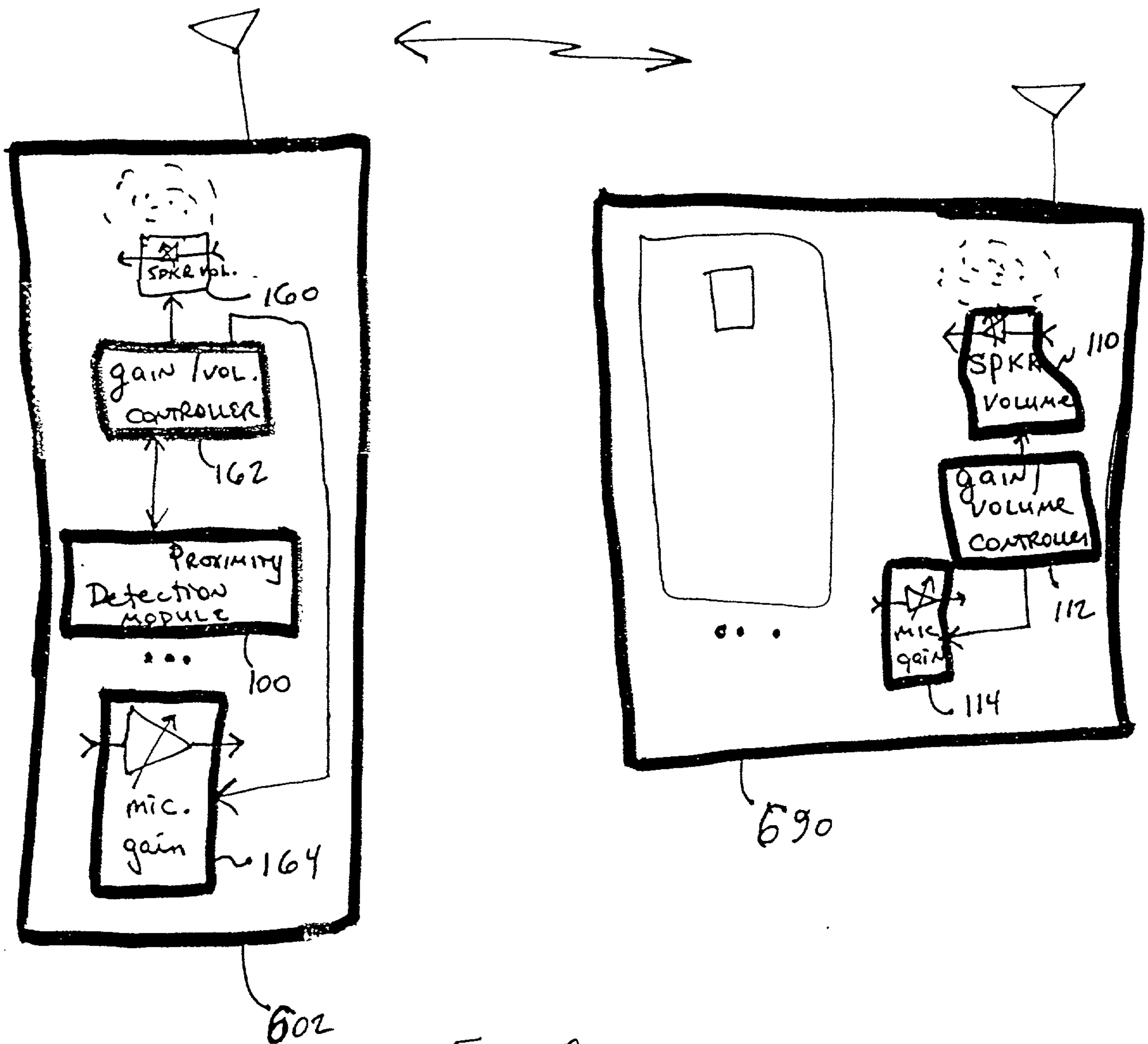

SPKR VOL.
160
gain / VOL. CONTROLLER
162
PROXIMITY Detection MODULE
100
mic. gain
164
602
SPKR Volume
110
gain Volume Controller
112
mic gain
114
690

FIG. 2

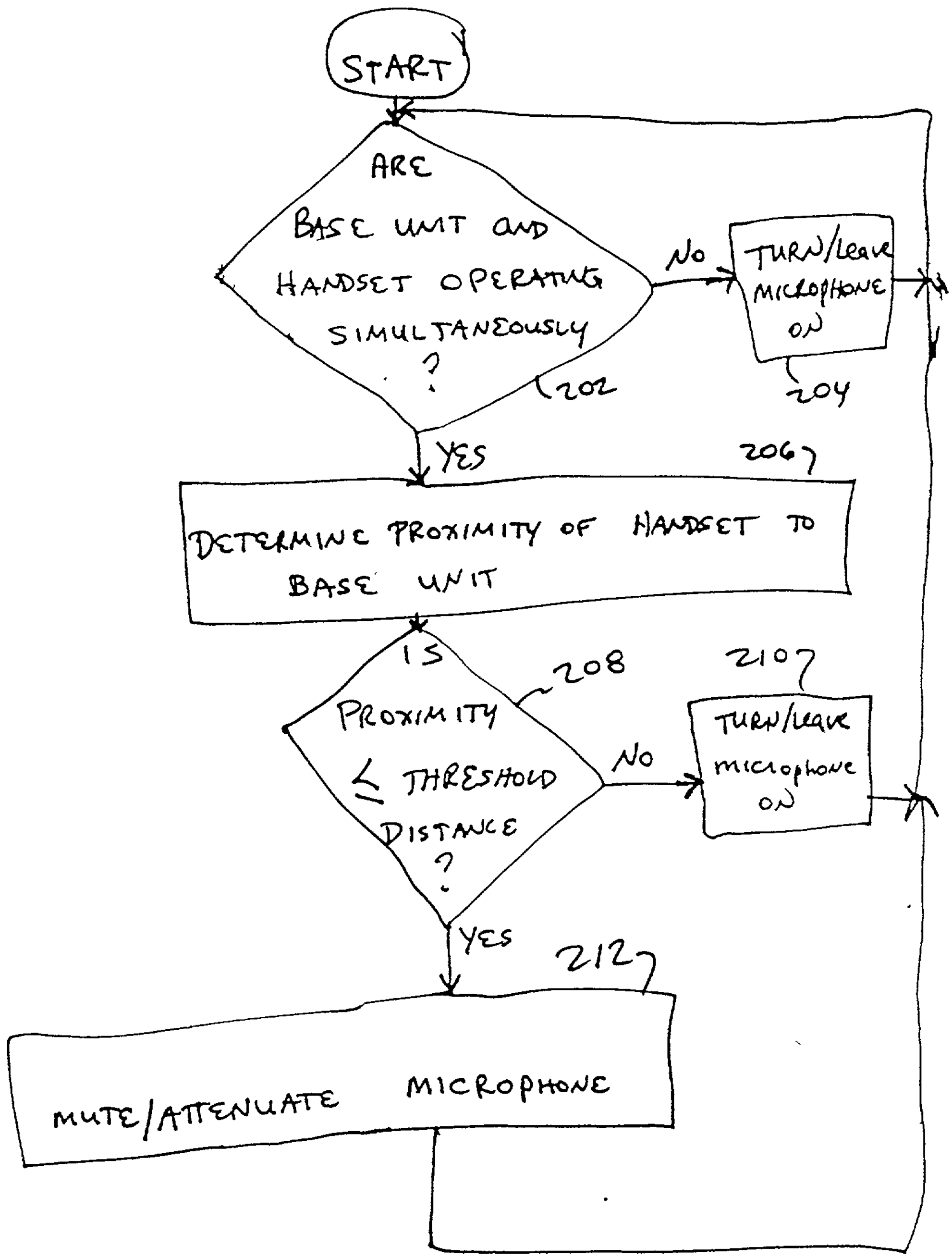

START
ARE BASE UNIT AND HANDSET OPERATING SIMULTANEOUSLY ?
202
No
TURN/LEAVE MICROPHONE ON
204
YES
206
DETERMINE PROXIMITY OF HANDSET TO BASE UNIT
IS PROXIMITY ≤ THRESHOLD DISTANCE ?
208
210
No
TURN/LEAVE MICROPHONE ON
YES
212
MUTE/ATTENUATE MICROPHONE

FIG. 3

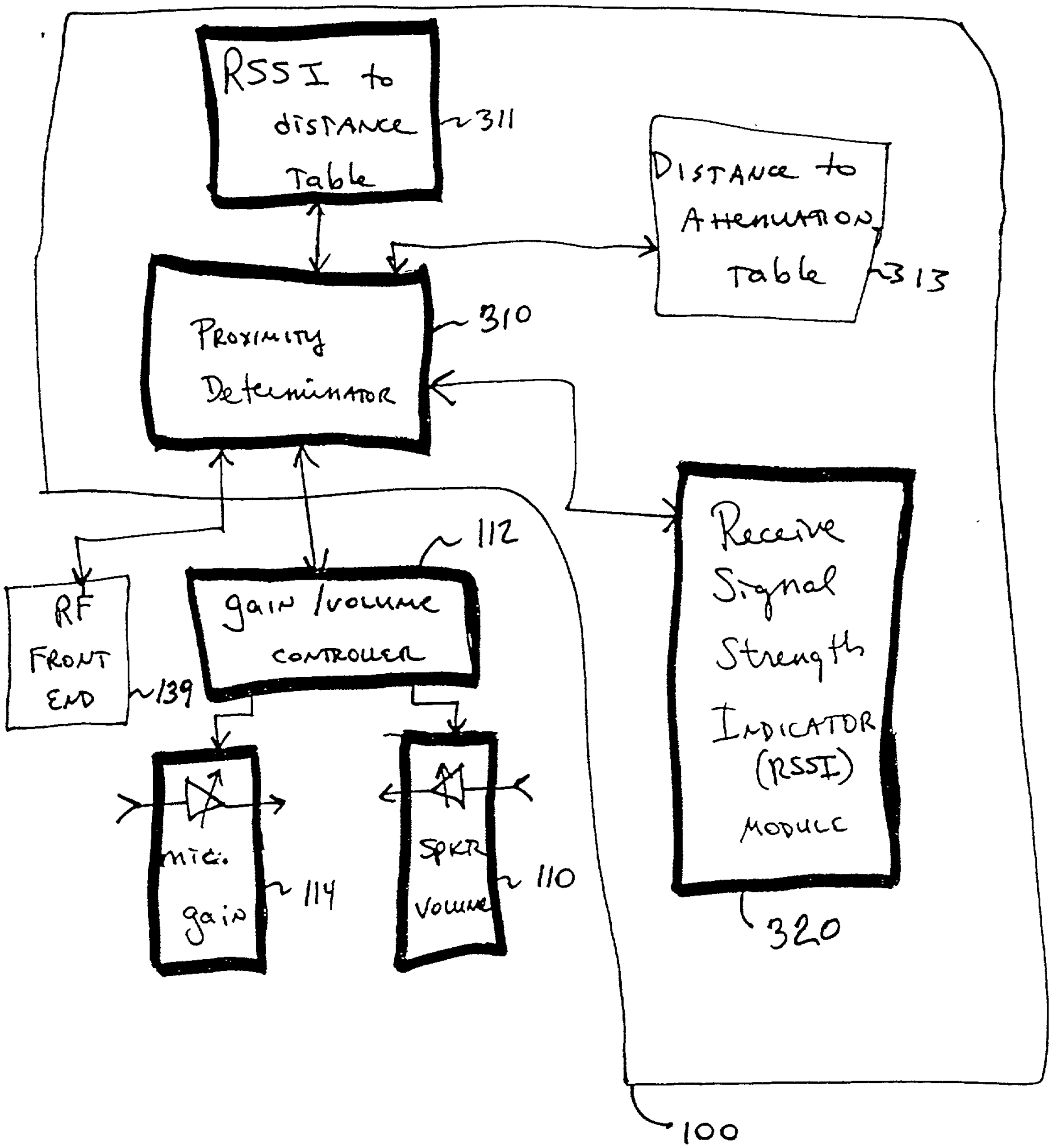
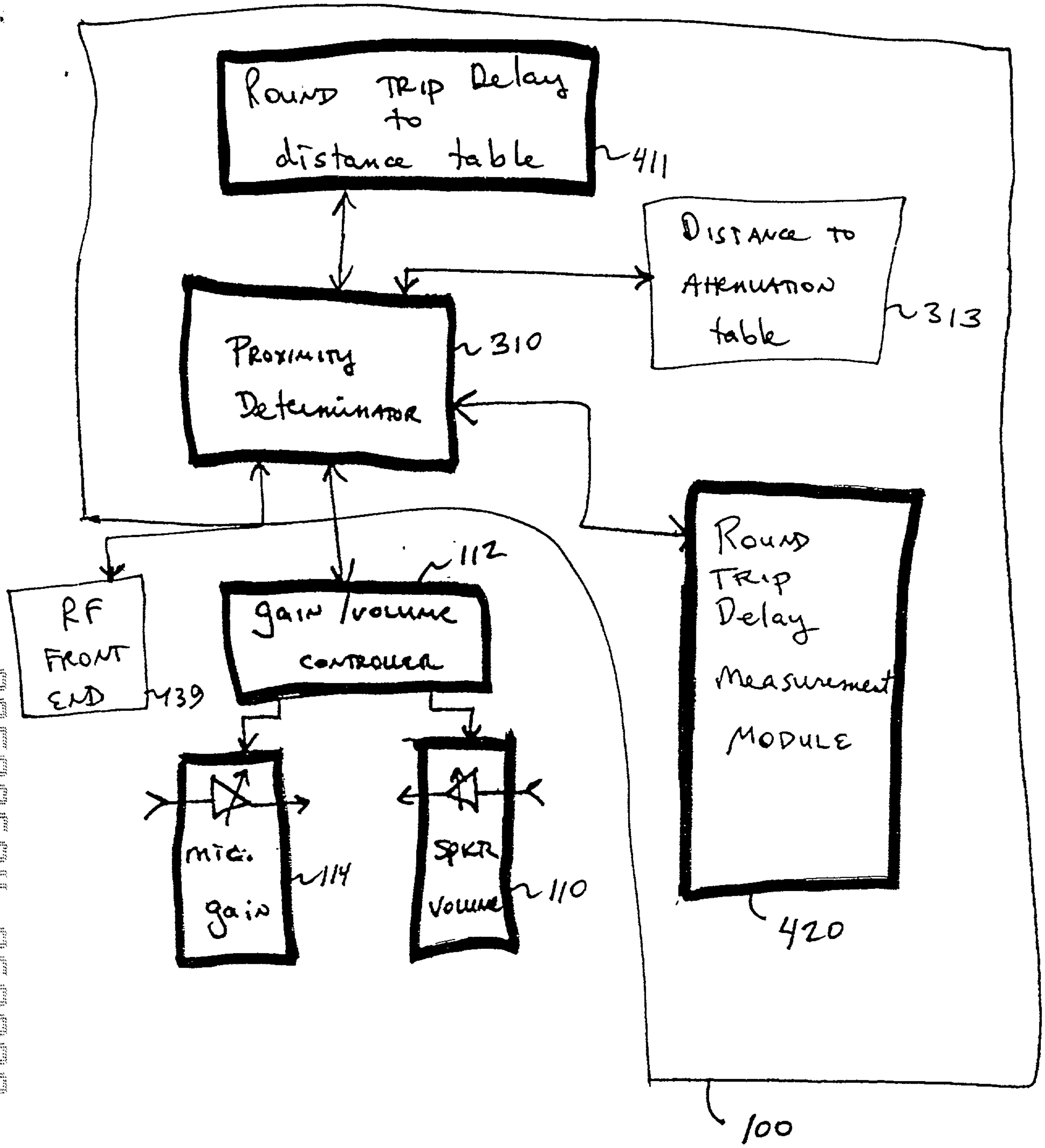
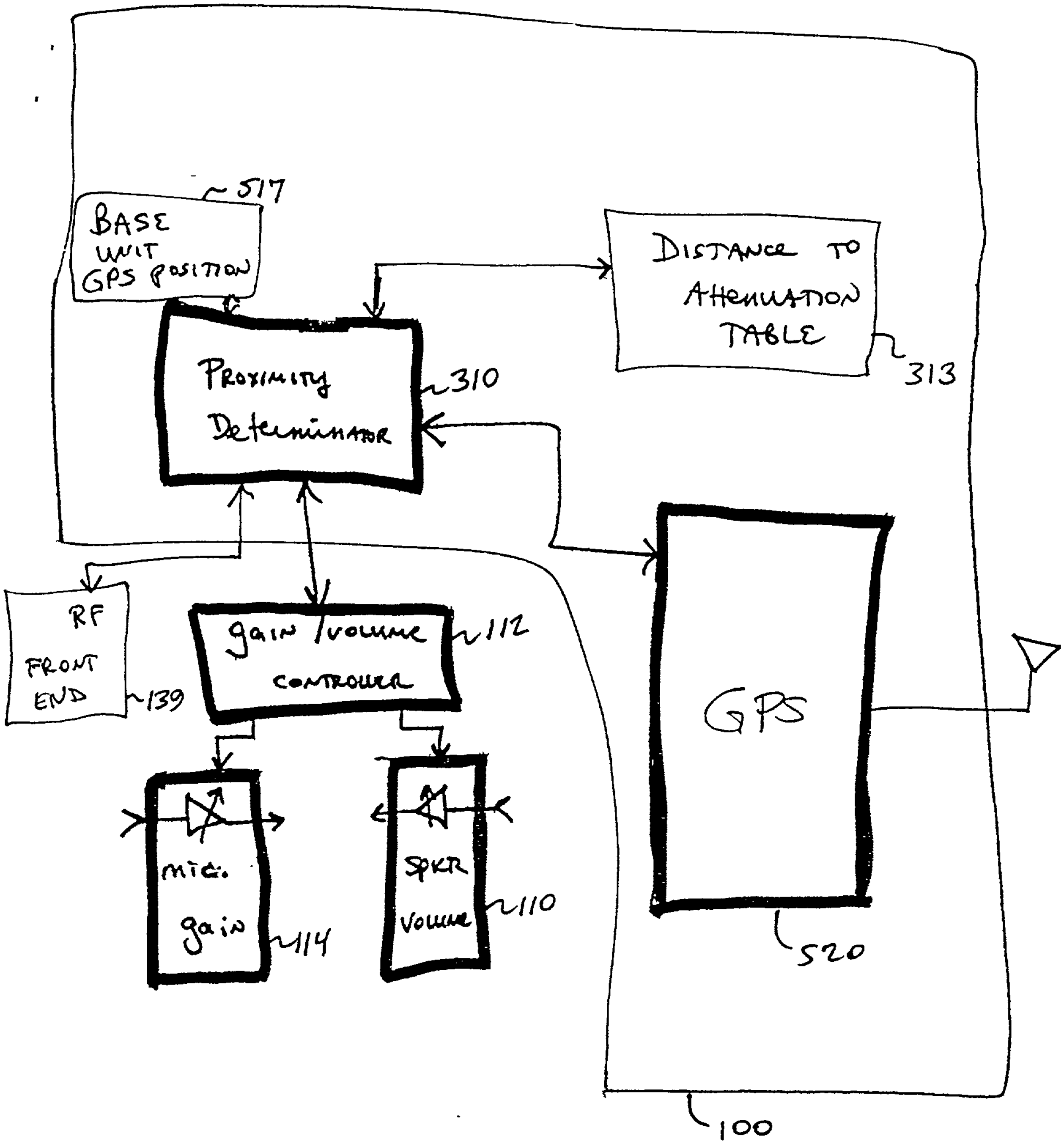

RSSI to distance Table
311
Distance to Attenuation Table
313
Proximity Determinator
310
RF FRONT END
139
112
gain /volume controller
mic. gain
114
SPKR volume
110
Receive Signal Strength Indicator (RSSI) MODULE
320
100

FIG. 4



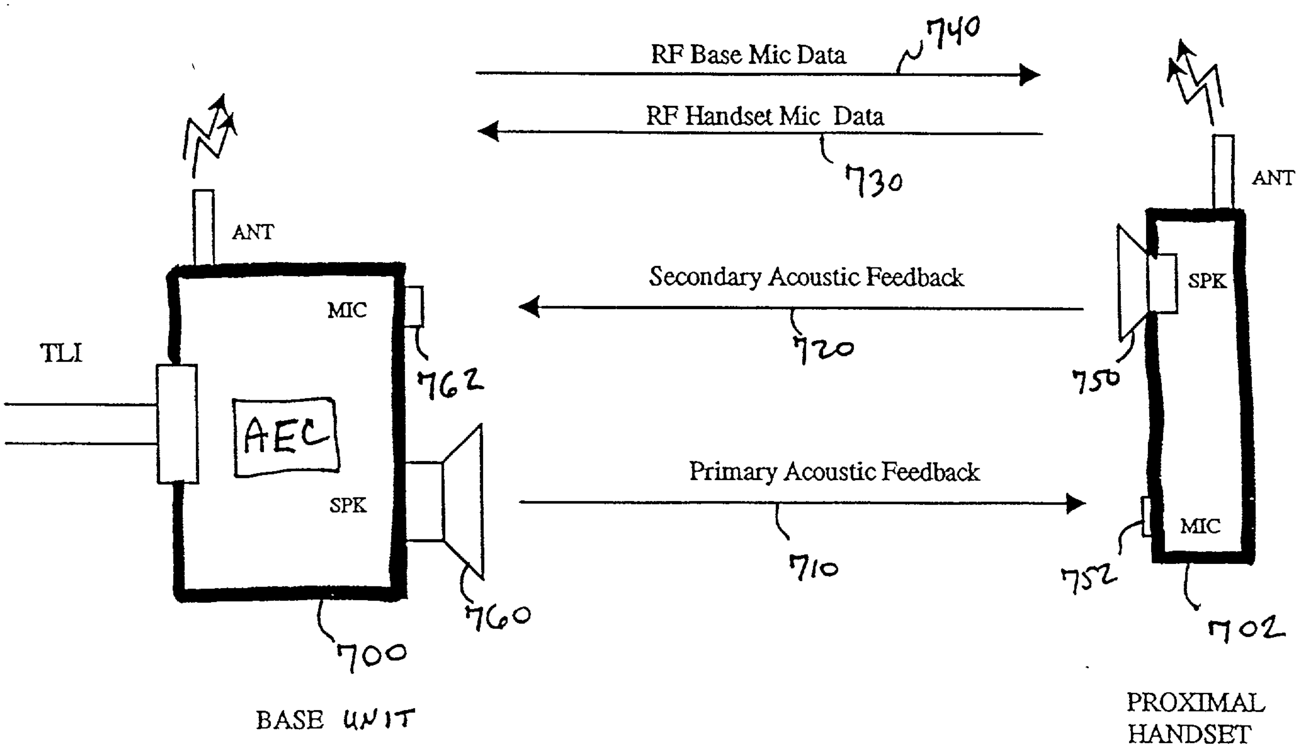
Round Trip Delay to distance table
411
Distance to Attenuation table
313
Proximity Determinator
310
RF Front End
439
gain/volume controller
112
Round Trip Delay Measurement Module
420
mic. gain
114
SPKR volume
110
100

FIG. 5



517
BASE UNIT GPS POSITION
DISTANCE TO ATTENUATION TABLE
313
PROXIMITY DETERMINATOR
310
RF FRONT END
139
gain /volume CONTROLLER
112
mic. gain
114
SPKR volume
110
GPS
520
100

FIG. 6



PRIOR ART

FIG. 7

CANNON 103-92-50 (690)

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Declaration and Power of Attorney

As the below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

We believe that we are the original, first and sole inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled **HANDSET PROXIMITY MUTING** the specification of which is attached hereto.

We hereby state that we have reviewed and understand the contents of the above identified specification, including the claims, as amended by an amendment, if any, specifically referred to in this oath or declaration.

We acknowledge the duty to disclose all information known to me which is material to patentability as defined in Title 37, Code of Federal Regulations, 1.56.

We hereby claim foreign priority benefits under Title 35, United States Code, 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

None

We hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, 112, we acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

None

We hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

We hereby appoint the following attorney(s) with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent and Trademark Office connected therewith:

Thomas J. Bean	(Reg. No. 44528)
Lester H. Birnbaum	(Reg. No. 25830)
Richard J. Botos	(Reg. No. 32016)
Jeffery J. Brosemer	(Reg. No. 36096)
Kenneth M. Brown	(Reg. No. 37590)
Donald P. Dinella	(Reg. No. 39961)
Guy Eriksen	(Reg. No. 41736)
Martin I. Finston	(Reg. No. 31613)
William S. Francos	(Reg. No. 38456)
Barry H. Freedman	(Reg. No. 26166)
Julio A. Garceran	(Reg. No. 37138)
Jimmy Goo	(Reg. No. 36528)
Anthony Grillo	(Reg. No. 36535)
Stephen M. Gurey	(Reg. No. 27336)
John M. Harman	(Reg. No. 38173)
Matthew J. Hodulik	(Reg. No. 36164)
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Mark A. Kurisko	(Reg. No. 38944)
Irena Lager	(Reg. No. 39260)
John B. MacIntyre	(Reg. No. 41170)
Christopher N. Malvone	(Reg. No. 34866)
Scott W. McLellan	(Reg. No. 30776)
Martin G. Meder	(Reg. No. 34674)
John C. Moran	(Reg. No. 30782)
Michael A. Morra	(Reg. No. 28975)
Gregory J. Murgia	(Reg. No. 41209)
Claude R. Narcisse	(Reg. No. 38979)
Joseph J. Opalach	(Reg. No. 36229)
Neil R. Ormos	(Reg. No. 35309)
Eugen E. Pacher	(Reg. No. 29964)
Jack R. Penrod	(Reg. No. 31864)
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Ronald D. Slusky	(Reg. No. 26585)
David L. Smith	(Reg. No. 30592)
Ozer M. N. Teitelbaum	(Reg. No. 36698)
John P. Veschi	(Reg. No. 39058)

David Volejnicek	(Reg. No. 29355)
Charles L. Warren	(Reg. No. 27407)
Jeffrey M. Weinick	(Reg. No. 36304)
Eli Weiss	(Reg. No. 17765)

We hereby appoint the attorney(s) on ATTACHMENT A as associate attorney(s) in the aforementioned application, with full power solely to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent and Trademark Office connected with the prosecution of said application. No other powers are granted to such associate attorney(s) and such associate attorney(s) are specifically denied any power of substitution or revocation.

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Full name of 2nd joint inventor: **James A. JOHANSON**

Inventor's signature *James A Johanson* Date *6/9/2000*

Residence: **Macungie, Lehigh County, Pennsylvania**

Citizenship: **USA**

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Full name of 3rd joint inventor: **Philip D. MOONEY**

Inventor's signature [signature] Date 6/9/00

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ATTACHMENT A

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